Materials Computation Center, University of Illinois

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Spintronics in Quantum Dots

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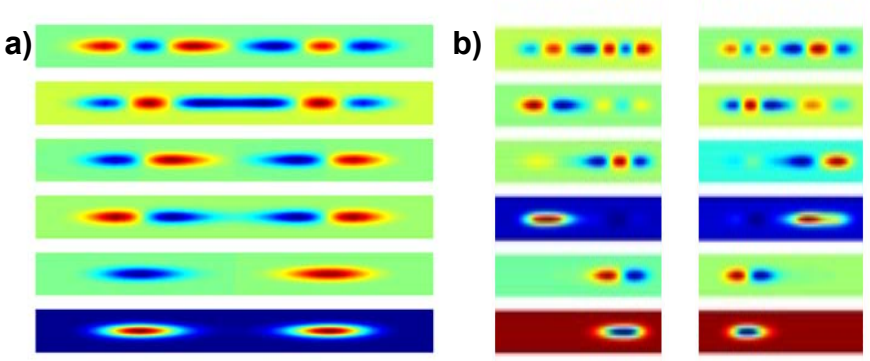
Research

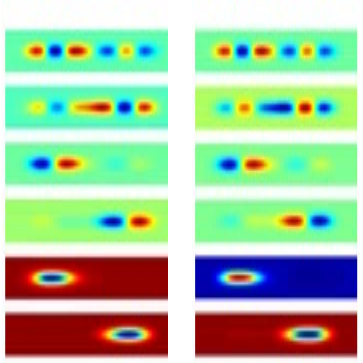
We are focused upon the understanding of many-body effects in semiconductor quantum dots (QDs) for applications in quantum information processing. More specifically, we concentrate on **material and design parameters** that influence the exchange interaction between conduction electrons in **realistic** double QDs. For this purpose, we use a **combined approach** based on *density functional theory* to model the QD potential, and *diffusion quantum Monte Carlo* to simulate accurately exchange and correlation of electrons in the QD.

We investigate vertically coupled QDs made in experiment by lithography techniques, which suffer from **inherent structural asymmetry** between dots due to limitation in fabrication technology. Density functional calculations show hybridization of single particle levels that disappear for higher states, and for increasing number of electrons. Monte Carlo simulations are in progress.

R. Ravishankar. P. Matagne, J.P. Leburton, R.M Martin and S. Tarucha, Phys. Rev. B, in review



Symmetryic vs. Asymmetric Quantum Dots (QD): single particle wave functions (WF) in a symmetric (a) and asymmetric (b) coupled QD. In a) the WFs are identical for both spins, while in b), the left and right panels are for spins up and down, respectively.



Field Effects: Restoration of symmetry in the single-particle WFs by external electric field in structurally asymmetric coupled QDs. Left and right panels are for spins up and down, respectively